and at Pleasanton, Nebr., on the 22d. Destructive thunderstorms occurred in Ohio on the 1st; in New Jersey on the 2d; in Minnesota, North Dakota, and Wisconsin on the 7th; in New York, Vermont, New Hampshire, Maine, Pennsylvania, Ohio, Indiana, Michigan, and Ontario on the 8th; in Tennessee on the 9th; in New Jersey the night of the 12-13th; in Minn tota, Indiana, and Maine on the 16th; in New Jersey, Pennsylvania, Maryland, and Illinois on the 17th; in North Carolina, Illinois, Missouri, and Iowa on the 18th; in Nebraska and Iowa on the 19th; in South Dakota and Iowa on the 20th; in Wyoming on the 21st; in Michigan on the 23d and 24th; in southeast Arizona on the 30th; and in New England, 31st. Damaging drought prevailed generally in Kansas, Nebraska, Bay, Wis., the early morning of the 18th.

and Iowa, and in parts of South Dakota, Minnesota, Arkansas, Texas, Tennessee, Kentucky, Illinois, Indiana, Ohio, Michigan, New York, Massachusetts, Maryland, Virginia, North Carolina, South Carolina, and Alabama.

Navigation was suspended on account of low water on the upper Ohio River, and on the Cumberland River at Nashville: and the Arkansas River at Fort Smith, Ark., was lower than

at any time since April, 1887.

Noteworthy auroral displays were observed at Sandusky, Ohio, the night of the 15-16th; at Huron and Rapid City, S. Dak., and Fort Buford, N. Dak., the night of the 16-17th; at Saint Vincent, Minn., the night of the 17-18th; and at Green

O ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

1890, as determined from observations taken daily at 8 a.m. and 8. p. m. (75th meridian time), is shown on chart ii by isobars. The departure of the mean pressure for July, 1890, obtained from observations taken twice daily at the hours named, from that determined from hourly observations, varied at the stations named below, as follows:

Station.	Departure.	Station.	Departure
Eastport, Me Boston, Mass New York City Philadelphia, Pa Washington City Savanuah, Ga Buffalo, N Detroit, Mich New Orleans, La Saint Paul, Minn	009 011 005 002 005 003 003	Duluth, Minn Chicago, III Cincinnati, Ohio Saint Louis, Mo Galveston, Tex. Santa Fé, N. Mex Denver, Colo Salt Lake City, Utah San Francisco, Cal San Diego, Cal	00 00 00 00 00

The mean pressure was highest over the Atlantic coast states south of the 40th parallel, and along the Pacific coast north of the 40th parallel, where it was above 30.05, and the mean pressure was lowest from southern Nevada southward over southeast California and west Arizona, where it was below 29.80. In the British Possessions north of west Montana the mean pressure was below 29.85, and on the northeast slope of the Rocky Mountains, over the southeast part of the southern plateau region, and in the lower Saint Lawrence valley the mean readings were below 29.90.

A comparison of the pressure chart for July with that of the preceding month shows that there was an increase in pressure over the greater part of the interior of the country, and that there was a decrease in pressure at extreme northern lake stations and thence eastward over the lower Saint Lawrence valley, over the Gulf States and Tennessee, and along the Pacific coast south of the 45th parallel, and thence eastward over the northern plateau region and the western parts of the middle and southern plateau regions. The greatest increase in pressure occurred at Atlantic coast stations north of the 39th parallel, where it was more than .05, and the most marked decrease in pressure was noted over the northern plateau region, and at stations in the Sacramento and San Joaquin valleys, California, where it was .05.

The mean pressure was above the normal from the upper Mississippi and Red River of the North valleys eastward, in the south Atlantic states, the northern part of the west Gulf states and thence westward over the eastern part of the plateau region, and on the Pacific coast north of the 35th parallel, and thence eastward over the northern and the northwest parts of the middle plateau region. The mean pressure was below the normal from Montana and the Dakotas southeast over the Missouri Valley and Kansas, on the south Pacific coast and

The distribution of mean atmospheric pressure for July, west Gulf states to the lower Rio Grande valley. The greatest departures above the normal pressure occurred along the Atlantic coast north of the 35th parallel, in the Saint Law. rence Valley, and at the more northern lower lake stations, where they exceeded .05. In districts where the mean pressure was below the normal the departures were less than .05.

A BAROMETRIC RANGES.

The monthly barometric ranges at the several Signal Service stations are shown in the table of miscellaneous meteorological The general rule, to which the monthly barometric ranges over the United States are found to conform, is that they increase with the latitude and decrease slightly, though somewhat irregularly, with increasing longitude. In July, 1890, the monthly ranges were greatest in the lower valley of the Red River of the North and in extreme eastern Maine. where they exceeded .70, whence they decreased southward to less than .30 over extreme southern Florida and in the lower Rio Grande valley, southwestward to less than .30 over the east part of the southern plateau region and on the south Pacific coast, and westward to less than .30 on the coast of northern California, and to less than .40 in Washington and Oregon. Along the Atlantic coast the monthly ranges varied from .24 at Key West, Fla., to .79 at Eastport, Me.; between the 82d and 92d meridians, .36 at New Orleans, La., to .66 at Marquette and Alpena, Mich.; between the Mississippi River and the Rocky Mountains, .28 at Abilene, Tex., to .80 at Saint Vincent, Minn.; in the Rocky Mountain and plateau regions, .21 at Fort Grant, Ariz., to .58 at Fort Custer, Mont.; on the Pacific coast, .24 at Eureka, Cal., to .45 at Fort Canby, Wash. Chart ii shows that in July, 1890, there was a range in mean pressure of .31 from the south Atlantic coast to the southern plateau region; a range of .16 from the southern plateau region to the south Pacific coast; a range of .20 from the south Atlantic coast to the lower Saint Lawrence valley; and a range of .29 from the British Possessions north of Montana to the Pacific coast north of the 40th parallel.

MIGH PRESSURE AREAS.

Within the limits of the United States the paths of 5 high pressure areas were charted during the month of July. rather remarkable that these had nearly a steady motion from the west to the east and this was much more uniform than is The permanent high area of the Pacific ordinarily the case. coast had an important bearing upon the origin of at least 3 of these areas. The eastern portion of this high area rested upon the California coast throughout the month, and, as will be noted later ou, there was a transference of offshoots from this to the plateau region and thence across the country. The table at the end of this description contains in concise form many of the characteristics of these high areas, and the following details are added:

I.—This had its origin to the north of the region of obserthence eastward over southern Nevada and Arizona, and from vation before the beginning of the month. Its general course Alabama westward over the lower Mississippi valley and the was southeast, just to the south of Lake Michigan, until it

reached the Atlantic on the 6th. At the coast, the Sargossa Sea high area, as shown by the Bermuda observations, moved to the west on this date, and the union of the two had a slow All trace disappears on 9th in movement to the southwest. the central Gulf. A well-marked fall in temperature preceded this area until it reached the most southerly latitude of its There was a remarkable fall of rain at isolated stations in its centre when it reached the south Atlantic states. Over 4 inches in 24 hours fell at Quitman, Ga., and over 2 inches at one other station in Ga. and at one in S. C.

II.—This was first noted to the north of Montana and had a path and velocity almost exactly the same as the former, except that the motion to the southwest continued only a half day. This area appeared to merge in the south Atlantic area on the 12th. The fall in temperature was much more pronounced than in I, but unlike I there was no rain for some dis-

tance from the centre.

III .- This was an offshoot from the Pacific high area and moved very slowly the first 2 days. On the night of 13th there was a transference, without motion probably, to the north of Montana. The course was a little south of east until 16th, when all trace is lost over Lake Erie. The fall in temperature was quite irregular in front of this area and not well marked. It was due mostly to a radiation from the earth to the clear sky, and apparently was not produced to any marked degree by the advance of a cool wave in front. On 16th this area spread itself from Lake Superior to the Gulf, making a partial connection with the permanent area in the southeast, perature occurred on 15th. and the north portion disappeared as already indicated.

IV.—This area had the longest duration of any during the month. Entering the country at Oregon on 15th it disapsoutheast and disappeared in Louisiana on 24th. peared off Nova Scotia on 23d. From first to last there was no rain was 0.85, at Leavenworth, Kans., on 21st. rain within this area. The temperature changes in its front

were quite insignificant.

V.—This was an offshoot from the Pacific area and passed into Oregon on 21st. All trace of it was lost in Colorado on 25th.

O LOW PRESSURE AREAS OR STORMS.

The storms of this mouth have been very erratic in their movements, as has been noted in previous years. It is often impossible to trace a track with accuracy, owing to the slight diminution of pressure. The principal characteristic of these storms has been a rather marked tendency to remain stationary, or at times to even reform toward the west; it is hardly probable that these reformations were due to a backward movement. There has been a noteworthy tendency for these storms to pursue a course in high latitude, even north of the Great Lakes. The reason for this may have been the persistency of the high areas in moving towards the southeast and in uniting with the permanent Atlantic high area, as noted above. None of these storms have had very high winds accompanying them at any station of observation with the exception of III, which had a velocity of 75 miles on 7th, at Moorhead, Minn. tracks of these storms, so far as they could be readily charted, will be found on chart I at the end of this REVIEW. principal characteristics of the storms are given in the table at the end, and the following details are added:

I .- This storm was first noted to the north of Lake Michi-It had a very slow motion down the Saint Lawrence Valley and disappeared in the Gulf of Saint Lawrence on the 5th. It had a slight intensity throughout its course, and had no marked rise in temperature in its front. The heaviest rainfall in 12 hours accompanying was at Parkersburgh, W. Va.,

1.80, 2d.

II.—This storm appeared to move south from N. W. T. on 3d. It was of short duration, being last noted on 6th in south Minnesota. The heaviest 12-hour rain was 0.44 at Fort Buford,

N. Dak., 5th.

III.—On the day when II was last noted there was a trough of low pressure extending from south Minnesota to N. W. T., and in some respects this storm may be considered as having these phenomena. its origin in the former. The motion of this storm was due

east and its path was near the parallel of 50° throughout its course. There was a rise in temperature of 28° on the 7th and a maximum fall of rain of 1.58 in 12 hours at Qu'Appelle, N.

W. T., on 6th.
IV.—For several days before the 8th the inclination of winds and a slight diminution in pressure indicated an atmospheric disturbance in the south plateau region. This disturbance culminated in a definite form on the evening of the 8th in south Idaho and moved with very slight intensity east and south, disappearing from view in Kansas on 11th. The heaviest rain in 12 hours was at Fort Elliott, Tex., 0.72, on 11th. No

marked change in temperature was noted.

V.—On the morning of 12th a disturbance appeared north of Montana and this caused a secondary in the evening in South Dakota. This secondary was traced for 2 days, disappearing 14th in Illinois, though a trough-like depression still continued from Illinois to the Saint Lawrence Valley for another day. The heaviest rain in 12 hours fell in connection with a thunderstorm on the night of the disappearance, 2.08 at Keokuk, 14-15th. There was a rise of 30° in temperature in 24 hours. XVI.—Like V, this storm originated north of Montana where there was an atmospheric disturbance on the days near the This storm had the most rapid motion of any during 15th. the month, 42 miles per hour. Its path was nearly due east. and it disappeared off the New England coast on 17th. heaviest rain in 12 hours was 1.38, at Atlantic City, N. J., the night of its disappearance. The greatest 24-hour rise in tem-

VII.—This storm had its rise to the north of Montana in a general disturbance on 18th. It had a slow motion to the southeast and disappeared in Louisiana on 24th. The heaviest

VIII.—For 2 days before 23d there was a general disturbance to the north of Lake Superior from which this storm was separated. On evening of 23d a trough-like depression extended from where VII had just disappeared to the lakes, and this trough continued till evening 25th. The heaviest general rains of the month were reported in connection with this trough. At least 20 stations reported rain exceeding 1.50 in 24 hours in the south Atlantic and east Gulf states. The storm moved nearly east and was last seen at the mouth of the Saint Lawrence on 27th. No marked rise in temperature occurred. The Lawrence, Mass., tornado was connected with this storm.

IX.—This storm, like IV, took its origin in the general and quite permanent summer depression of the south plateau. Its progress was quite rapid in an east-northeast direction, disappearing from view on morning of 31st in Ontario. The heaviest rain in 12 hours was 1.58 at Rockliffe, Ont., on 31st. No

marked rise in temperature occurred in its front.

On comparison with the storms of previous years it is found that, with one or two exceptions, they have originated either to the north of Montana or in the south plateau region and have almost invariably had a tendency to move in the higher latitudes, just as has been the case during this July. A short investigation has also been made in order to determine whether the velocity, intensity, or any other characteristic of high areas or storms may be connected in any way with the magnitude of the diurnal range of the barometer. The barograph curves at about 20 stations were examined for each day of the month and the magnitude of the diurnal range tabulated on a scale 0-3. It was found that the appearance of the curve changed greatly from day to day, especially at the northern stations. On charting these figures it was found that the magnitude of the diurnal range was uniform over very great areas, and these areas of equal magnitude had a slow motion toward the west or else remained nearly stationary. There was a slight tendency to an increase in the magnitude on the west side of high areas, but it cannot be said that there was any direct and marked connection between

In order to compare the relative velocity of high and low

areas the following arrangement is given, in which the consecutive positions and velocities of the two are placed in chronological order:

June. Number I H I L II H II L III L 1V L III H IV H V L VI L VII L VIII L V H Velocity 21 20 20 21 30 14 18 23 21 24 9 12 14 July.

Number IL IH IIL IIIL IIH IVL VL IIIH VIL IVH VIIL VH VIIIL IXL Velocity II 22 13 29 24 20 14 29 42 19 17 16 18 35

There seems to be quite a remarkable uniformity in the

gradual rise and fall of these velocities, and this is more surprising when we consider that in some cases the motion is made up for a large number of days while in others for a very few days.

A comparison with storms of previous years is given in the following table:

Year.	Number.	Velocity per hour.	Year.	Number.	Velocity per hour.		
1874	6 6 7	Miles. 22.9 23,6 24.3 22.8 20.9 26.2 25.2 24.2	1883 1884 1885 1886 1887 1888 1889 1899	8 9 7 7	Miles. 29. 9 21. 9 27. 6 21. 3 22. 6 23. 3 22. 1		

Tabulated statement showing principal characteristics of areas of high and low pressure.

Barometer.		First observed.		Last observed.			r hour.	Maximum pressure change and maximum abnormal temperature change in twelve hours and maximum wind velocity.									
	Date.	Lat. N.	Long. W.	Lat. N.	Long. W.	urati	Velocity per	Station.	Rise.	Date.	Station.	Fall.	Date.	Station.	Direction.	Miles per hour.	Date
High areas. IIIIIIIIIV V Mean	8 13 15 21	47 51 47 46 47	0 112 107 122 126 125	27 33 43 47 40	90 78 81 59	Days. 7.5 4.0 3.5 8.0 3.5	Miles. 22 24 29 19 16	Dubuque, Iowa	.40	4 9 14 17 21	Buffalo, N. Y Rockliffe, Ont North Platte, Nebr Huron, S. Dak Denver, Colo	0 16 22 19 14 15	4 9 14 17 22	Fort Assinniboine, Mont. Philadelphia, Pa. Qu'Appelle, N. W. T. Chicago, Ill. Fort Canby, Wash.	ne. n. nw. e. ne.	30 14 12 16 14	11 14 19 22
Low areas. II. III. IV. VI. VII. VIII. VIII. IX.	1 36 8 12 15 18 23	48 51 52 43	83 115 110 116 101 108 113 87	49 44 50 38 41 42 31 50 48	67 96 62 101 90 69 92 67 76	5·3 4·0 3·0 3·0 2·5 2·0 6·0 3·5 2·5	11 13 29 20 14 42 17 18	Buffalo, N. Y. Fort Sully, S. Dak. Chatham, N. B. Fort Custer, Mont Huron, S. Dak. Nantucket, Mass. Qu'Appelle, N. W. T. Eastport, Me. Fort Buford, N. Dak.	Fall.	1 4 8 11 12 17 18 25 29	Duluth, Minn Rapid City, S. Dakdo Fort Sully, S. Dak Rapid City, B. Dak Cheyenne, Wyo Pueblo, Colo Eastport, Me Oawego, N. Y	Rise. 12 16 18 18 18	1 4 6 9 12 15 23 26 31	Toledo, Ohio Sioux City, Iowa Moorhead, Minn Valentine, Nebr Chicago, Ilil Rawlins, Wyo Fort Assimiboine, Mont. Block Island, R. I Rawlins, Wyo	s. nw. s. ne. nw. s.	26 42 76 48 48 48 42 36 48	1 1 1 2 3
Mean		. 				3.2	22		- 27	••••	••••••	15				42	

O NORTH ATLANTIC STORMS FOR JULY, 1890 (pressure in inches and millimetres; wind-force by Beaufort scale).

lantic Ocean during July, 1890, are shown on chart i. These paths have been determined from international observations Department, and the "New York Herald Weather Service."

number for the corresponding month of the last seven years ways. In 1886 two storms advanced frebeing 7. Of the storms traced for the current month 5 were neither of which was very destructive. continuations of depressions which first appeared over the North American continent; 1 apparently originated north of the Bermudas; and 2 were first located east of the 20th meridian. The storms pursued normal east to northeast paths, and no storm traversed the ocean from coast to coast. Generally fine weather prevailed over the north Atlantic during the month, the more important disturbances occurring south of Newfoundland on the 5th, when fresh to strong gales were reported; over mid-ocean in high latitudes on the 30th and 31st, when pressure ranging from 29.20 (742) to 29.40 (747) and fresh to strong settled weather prevailed over mid-ocean with the advance of 7th and 27th, when the pressure fell below 29.50 (749), and moderate to fresh gales were encountered. In July of pre-Ocean, the most destructive storms of the month generally central over the Gulf of Saint Lawrence, having advanced from appearing in the sub-tropical or tropical regions. Among the westward, with pressure below 29.40 (747); by the 10th notable West Indian cyclones for July described in the RE-

The paths of the storms that appeared over the north At- | ward over the Caribbean Sea and thence northward over the Gulf of Mexico to the east Gulf states from the 20th to the close of the month. This storm was very severe at Barbadoes Island on the 20th, and several vessels were wrecked. Sev. by captains of ocean steamships and sailing vessels received eral vessels were wrecked on the north Cuban coast and on through the co-operation of the Hydrographic Office, Navy the west coast of Florida, and very heavy rainfall in the Gulf States, in connection with high winds and swollen rivers. Eight storms have been traced for July, 1890, the average caused great destruction to growing crops and public high. ways. In 1886 two storms advanced from the vicinity of Cuba.

July, 1890, opened with low pressure over the British Isles. and there was evidence of a disturbance north or northeast of the Bermudas. On the 2d a storm of slight energy was central south of Newfoundland, whence it apparently moved north. ward and united with another in the Saint Lawrence Valley. Over the eastern part of the ocean unsettled weather continued until the 5th. From the 5th to 7th fresh gales attended the passage of a storm from the lower Saint Lawrence valley to northeast of Newfoundland, and during the 7th and 8th un. gales were noted; and to the west of the British Isles on the this storm to the northward. On the 7th a storm was central west of Ireland, having advanced from the westward, with pressure below 29.50 (749) and fresh gales, and under the ceding years storms of marked strength have seldom been influence of this storm unsettled weather continued over and encountered in the middle latitudes of the north Atlantic near the British Isles until the 10th. On the 9th a storm was VIEW during the last seven years were those of 1886 and 1887. servation. On the 13th and 14th low pressure prevailed over The hurricane of 1887 advanced from Barbadoes Island west- the British Isles, probably attending the passage of a storm to